ON ARTIFICIAL LIGHT

FROM

SOLID SUBSTANCES, AND THE MANUFACTURE OF CANDLES.

BY THE SECRETARY.

Read December 11, 1832.

IF the discovery of artificial, domestic, or culinary fire, ranks amongst the most useful (and probably among the very earliest) of human inventions, that of artificial light stands in the next degree of importance. Even in the tropical regions, where the diurnal revolution of the earth distributes light and darkness in alternate portions of twelve hours each, it would be extremely irksome and inconvenient to have to pass all the hours of night in a state of darkness. The body wearied with labour, and the mind with sensation and with thinking, are restored to vigour at a far less cost than half the time of human life. But if the interchange of light and darkness by *equal* alternations would be attended by so much loss of active existence, and therefore of so much usefulness and enjoyment, still greater would be the loss suffered by those whose lot had been cast in countries beyond the tropics, and therefore nearer to the poles; for here the intervals of light and darkness not being equal through the year, a winter's night drawn out to sixteen hours or more, would leave only one-third of the time at such

seasons applicable to the demands of active life, whether of necessary labour or agreeable recreation.

This seeming niggardliness of nature in the article of light, has, from the very first beginnings of human society, been stimulating the wit of man to find out better and better substitutes for the light of day, and capable from their portability of being brought into mines, cellars, and other places where even the light of the sun cannot penetrate.

All the common methods of producing warmth are only modifications of combustion; and, as combustion implies not merely the evolution of heat, but of light also, the inventor of fire was likewise the inventor of artificial light. In the mythology of the Greeks, Prometheus, an impersonation of wisdom greater than human, conveyed by stealth from the celestial regions the first fire, and bestowed on wretched mortals the splendid and invaluable gift. But whensoever and by the ministry of whomsoever artificial fire was derived to men, together with the art of preserving it by due supplies of fuel, from the same time began the discovery of artificial light. At first, men would be satisfied with the light of a blazing fire fed with pine, or other resinous wood. It would then be discovered that the roots of such trees, being richer in resin than the trunks and branches, might be conveniently reserved for use when a brighter light than common was wanted. The art of tearing these roots up into strips and making of them portable lights, would speedily follow; an art in use, even at the present day, in some of the poorest and most remote districts of our own country. In the western islands of Scotland, and the western parts of Ireland, the roots of fir found in the peat-mosses are actually applied to this very purpose.

The invention of torches—that is, of staves of combustible wood smeared over with resin, would be the next stage of improvement; and, in the poems of Homer, we find no mention of artificial light at that time in use except of torches, held by attendants or by statues. Thus, the great hall in the palace of Menelaus at Lacedemon, which is represented as exceedingly splendid, was lighted by torches placed in the hands of statues. The hall of Ulysses in Ithaca was lighted by three braziers filled with billet-wood, assisted by some torches. Penelope works her web by torch-light; people go to bed by torch-light. In short, whenever an artificial light is wanted, it is obtained either by burning wood, or by a torch.

The combustibility of animal fat was also, no doubt, well known at that time; but, it being the custom to burn, in gratitude to the gods, a part of every domestic animal slaughtered for food, nearly the whole of the interior fat, or suet, was thus employed; so that, after reserving the supply necessary for domestic use, it is probable that none would remain applicable as a material for light.

In the valleys of the Euphrates and the Nile, the cradles in all likelihood of human civilisation, the annual inundation of the rivers, although extremely favourable to an exuberant fertility of agricultural produce, is not kindly to the growth of trees, especially of the resinous sorts. Here, therefore, it was that the art of extracting oil by pressure from the seeds of the sesamum, and of other plants cultivated for this purpose, was perhaps invented, as well as the method of burning them for light by means of a wick.

When the art of making candles was first discovered, I do not know; but both the name and the thing were

familiar to the Romans in the time of Trojan, as is evident from the Natural History of Pliny, and from other authorities. They were first made of strings dipped in resin, or coated with wax; afterwards, for wicks, were employed a thin roll of papyrus; and, lastly, the common rush, with the rind or outer skin peeled off, exactly as it is used at present for those slow-burning candles called watch, or rush-lights. For funeral ceremonies, wax candles were employed; for domestic use, tallow candles.

On the present occasion I shall treat of the manufacture of candles, and on some other matters closely connected with this branch of our subject. It will, of course, be understood that I do not profess to teach the art of making candles, but only to give such a general view of the manufacture as may satisfy a liberal curiosity, and communicate the information necessary to enable you to understand the remarks with which I shall conclude.

For the practical details on the manufacture of tallow candles, I am chiefly indebted to Mr. Barton of Bishopsgate; and for those on the manufacture of spermaceti and wax candles, together with several of the specimens now exhibited, I am indebted to Mr. Miller of Compton Street.

Nearly the whole of our imported tallow comes from Russia. In the year 1829, 58,890 tons were entered at the custom-house, the greater part of which, I apprehend, is used by the candle-makers. The quality of imported tallow varies greatly, the inferior kinds being employed in lubricating machinery, and for other similar purposes: that which is of a yellow colour, and free from rancidity, is the fittest for candles. A large quantity, also, of candle tallow (estimated at about double the amount of that

which is imported), is of home growth. This latter is fitted for use by the tallow *renderer,* who chops into pieces the fat and suet, as it is received from the butchers, and boils it in water; the greater part of the fat is thus melted out from the membranes in which it is naturally contained, and floats on the surface of the water. The membraneous part is then collected and submitted to the graduated action of a strong press, by which the rest of the fat is squeezed out. What remains is a cake or block of a dark colour, going by the name of *graves*, and consisting chiefly of condensed membrane: by maceration in warm water it softens and swells, and in this state is a palatable and wholesome food for many domestic animals. The poultry, both chickens and ducks, fatted for the London market, are fed in part on this substance.

The wicks are made of loose-spun cotton-yarn. That which is employed for common candles is American cotton, spun in London; but, for mould candles of the best quality, yarn imported in bales from Turkey is used. This latter is dearer than the other, but is considered to have a better body, and, being spun by hand, is also better, being looser twisted.

The tallow, being mixed so as to suit the quality of the candles intended to be made, is put into a boiler with some water, to prevent it from being over-heated, and is here melted at a temperature of about 90°. Some water is then sprinkled into it, which determines the subsidence of the dregs: the clear tallow is let out by a cock, and when sufficiently cooled, but still retaining its perfect transparent fluidity, is fit for use. There is, no doubt, a considerable difference in the temperature at which tallow melts. The fat about the kidneys in all animals is harder and less fusible than that contained in the cells

of the bones, and especially than the half-oily fat which is found in the muscles and other soft parts. The fat from the same parts of the body is also harder in some animals than in others; that of the sheep and deer, for example, congealing much more quickly than that of the ox and horse. Now, in proportion as any particular sample of tallow is made up of the kinds of fat above enumerated, will be its fusibility; and, therefore, the temperature of 92°, which is generally stated to be the melting point of tallow, although no doubt correct with regard to that particular specimen which was the subject of examination, is by no means so as applied to all kinds of tallow. I saw, the other day, a boiler full of tallow, not only perfectly fluid at 72°, but even then not sufficiently cool to be made into candles; nor was its fusibility considered as at all remarkable: whence we may conclude that tallow, made into candles and exposed to the air, loses much of its fusibility.

The proportion of wick in dipped candles varies from 2 to 2½ oz. for every 12 pounds of tallow; whereas, for mould candles, 1½ to 1¾ oz. is sufficient; whence it follows, that the latter are made of better — that is, of less fusible tallow, than the former; for, in proportion to the fusibility of the tallow is the thickness of wick required to prevent the candle from guttering.

In making dipped candles, the wicks are strung by their looped end on wooden rods, and are then let down gently and perpendicularly into the melted tallow, a layer of which incrusts each wick all round; after two or three dips, the rods are exposed to the air, till the tallow has become quite cold and firm; the dipping is then to be repeated, and so on successively till the candles have acquired their proper thickness. Hence, when a dipped

candle is broken across, it will be found to be composed of as many concentric layers as there have been dips.

Mould candles are made in cylindrical pewter moulds, open at top and terminating below in a cone or blunt point, the extremity of which is perforated. Ten or a dozen of them are fixed perpendicularly in two rows in a wooden frame, the top of which is a shallow quadrangular trough. A hooked wire is passed down the mould till it comes out at the perforated end, the loop of the wick is hung on the hook, and by means of it is drawn upwards till only about half an inch of the wick remains on the outside. The hook is then disengaged, and a horizontal wire is thrust through all the loops of one row, which holds the wicks stretched and perpendicular in the axis of their respective moulds. The melted tallow is then poured into the trough, whence it runs down and fills every mould. The tallow remaining in the trough is then scraped out, and as soon as the moulds have got sufficiently cool, the candles are drawn out by their looped ends, which are afterwards cut off; for the candles are cast in an inverted position, the conical end being the top of the candle.

A recently made candle of good quality is of a yellow colour, is soft, and will be found to spit or sputter when set fire to, and to give a comparatively feeble light, the two latter qualities shewing that it contains a little water. If kept for three or four months in a box placed in a cellar (for the presence of the sun's light is by no means necessary), the candle will be found bleached both inside and outside, will be harder than at first, and will now burn with a clear flame undisturbed by any sputtering: it is evident, therefore, that the water has been evaporated, and it is also extremely probable that the water,

or the air which the water holds in solution, has acted chemically on the tallow, bleaching and, at the same time, hardening it. This bleaching process goes on slowly in a cold and damp atmosphere, it being found that autumn-made candles hardly ever bleach to a good colour, although in three or four months they are fit for use. Candles made in March, bleach the best of any; for the three or four months during which they are kept in the manufacturer's store, are usually both dry and warm.

Another article employed in the manufacture of candles is spermaceti. This is the produce of a large animal of the tribe of whales, called Physeter macrocephalus, or Cachalot whale. It is of quite a different genus from the Greenland whale, having strong conical teeth in both jaws, whereas the latter animal has none. At present, its principal places of resort are near the Seychelles islands, the Japanese seas, and especially the sea to the south of Van Dieman's Land. The adventurers from the latter place have of late been very successful, the whole importation of rough spermaceti oil last year amounting to about 7000 tons, which is 1000 tons more than the usual average; a redundancy that has occasioned a reduction in the wholesale price of spermaceti of near forty per cent. The blubber of the cachalot—that is, the fat which covers the body, contains about one-seventh of its weight of spermaceti; but the oil contained in a large triangular cavity in the head of the animal, yields about two-fifths of the same. The common opinion, that it is the brain, is quite a mistake, there being no connexion between the cavity containing the brain and that in which the spermaceti is found.

The first process in bringing the spermaceti to a state fit for the candle-maker is to separate it from the oil by

pouring the mixture into woollen bags. The oil which thus drops through is sperm oil of the best quality; and the residue is a brown, greasy, scaly mass, called bag-spermaceti. This latter is transferred to canvass bags holding about six gallons; several of these are laid one upon another on the floor of a press, and are exposed for several hours to a strong and slowly increasing pressure. Most of the remaining oil is thus separated, but its quality is considerably inferior to the first runnings. What remains in the bags is brown spermaceti; and, before the happy thought of using it for candles occurred, the only demand for spermaceti was as a medicine: this demand was soon satisfied, and, a century ago, many tons of this now valuable substance were every year thrown into the Thames at Puddle Dock.

The brown spermaceti is now put into a boiler, where it is heated with a mild alkaline lie for the purpose of clearing it from the greater part of the colouring matter, and of the oil that the press was unable to force out. The alkali, even in its mild or carbonated state, is capable of uniting with the oil and most of the impurities, while it has no action (unless previously rendered caustic) on the spermaceti. By this process, the alkaline solution becomes of a dark brownish black colour, and the spermaceti is carefully skimmed off the surface and cast into cakes. These cakes, still brown, are ground to a flaky powder, which is laid on coarse linen cloth, and formed into perfectly even layers. The ends of the cloth are folded over, so as to make a packet of uniform thickness; a number of these packets are then laid edgewise in a kind of trough alternately with flat plates of iron, and are exposed to the action of a very powerful horizontal press, by which a little more oil is got out. The

cloths being then opened, the cakes of spermaceti are put into a boiler and melted. When at the temperature of 240°, a little mild alkaline lie is thrown in, which converts part of the remaining oil and colouring matter into an imperfect soap; and, a minute after, a cupful of cold water is sprinkled in. This, as it descends through the melted spermaceti, is soon converted into steam, and rises again, exciting much frothing and effervescence, and brings up with it all the brown soapy matter produced by the previously added alkali. By continuing this process for several hours (a pan of 25 cwt. requiring 12 or 14 hours), the colouring matter and other impurities are completely got rid of, and the spermaceti in fusion becomes beautifully clear and quite colourless, like so much water. It is then cooled and poured into moulds, where it becomes solid and crystallized within, forming block spermaceti.

So strong is the tendency of this beautiful substance to crystallize, that candles made entirely of it would be very liable to crack longitudinally in cooling. To prevent this, one ounce of white bees' wax is mixed with each pound of spermaceti; and the whole being melted together, produces a compound more compact and less crystalline than pure spermaceti, and better fitted for the manufacture of candles. The process of making spermaceti candles differs in no respect from that used in the manufacture of tallow moulds, already described.

Another solid oily substance, of which candles of the very best quality are made, is bees' wax.

From inquiries that I have personally made, I learn that the quantity of wax of home growth that finds its way to market is exceedingly small; nearly the whole supply of this commodity may therefore be said to be imported: the

average yearly quantity is about 460 tons, but of this about half is re-exported. More than one-third of the whole comes from the western coast of Africa, chiefly from Mogadore; Cuba, Russia, and the Barbary states send, together, about as much as Mogadore does: the remainder is brought in small quantities from the Netherlands, France, and various other countries.

It comes to us in the state of crude yellow wax, and requires to be purified and bleached before it is fit for the candle-maker. The impurities are separated chiefly by melting; those that are heavy sinking to the bottom of the boiler, and the light ones rising to the top, whence they are removed by skimming. The bleaching is performed by exposing the wax, in thin ribands or shavings, to the sun and the dew; and it is brought into the form of ribands by pouring the melted wax in a thin stream on a cylinder revolving in water.

Refined wax is liable to become brown, if melted by a naked fire; a steam heat is, therefore, very generally used for this purpose. It is impossible to make wax candles in moulds, as those of tallow and spermaceti are; because the wax, becoming solid, adheres so closely to the mould as to make it a matter of extreme difficulty to get it out. They are therefore made by a kind of dipping, in the following way:—In the first place, a hollow cylinder of tin pipe about an inch long, called a tag, is threaded on to one end of the wick, the loop being at the other end. The wicks so prepared are then hung by their loops on hooks, attached to a hoop suspended in a horizontal position, and capable of being turned round. The pan in which the melted wax is contained is flattened out at the rim, and over this rim the hoop is suspended. The workman, with one hand, turns the hoop round, and with the

other pours melted wax over each wick in succession. Part of the wax cools and sets as it runs down the wick, forming a mass of an imperfectly conical figure. When the candle has thus attained half its size, it is unhooked, turned bottom upwards, and hung on again, the thick part being now at the top: melted wax is then again poured on each candle in succession, till it is brought to the proper size, and has attained a more or less correct cylindrical figure. It is then removed from the hoop, and the conical form is given to the top of the candle by laying it on a table, and pressing the end of a board, cut slanting, on that part of the candle which is just below the tag, giving it, at the same time, a rolling motion. The candle is then finished by being rolled backwards and forwards, three or four times, on a moist marble slab, being at the same time pressed above by a smooth board; this rectifies the cylindrical figure of the candle, and gives it a degree of glossiness or polish: finally, it is brought to the proper length and weight, by cutting a piece off the end.

In rough spermaceti oil, simple inspection is sufficient to shew that, at the common atmospheric temperature, it consists of two distinct substances; one of which is solid, and in the form of scales, and the other liquid. At a less heat than that required for the fusion of the spermaceti separately, these scales melt, forming, with the part already fluid, an uniform liquid. By lowering the heat, the scales of spermaceti again separate from the oil; and at the temperature of freezing water, the oil itself becomes a soft buttery solid. Modern discoveries have shewn that many other oily substances, both animal and vegetable, consist likewise of two ingredients, one less fusible than the other; and many attempts have been made, with more or less success, to bring these discoveries made in the

laboratories of chemists into practical use. Thus, common tallow, though it appears to be a very homogeneous substance in the solid state, yet if a few gallons of it are melted, and stirred gently while cooling, we shall see that, previous to its consolidation, it consists of a fine scaly matter diffused in a substance that is still liquid. If, in this condition, it was poured into woollen bags, placed in a room kept accurately at the proper temperature, there seems no reason to doubt that the oily part would drip away, leaving behind the scaly matter; and that this latter, exposed afterwards to a regulated pressure, might, like bagged spermaceti, be still further deprived of its oil. By processes analogous, in all probability, to those just mentioned, the less fusible part of tallow has been actually separated, and, under the name of stearine, has been employed as a material for candles. Though more fusible than spermaceti, it is less so than entire tallow,—is harder than this latter, and, being capable of bearing a somewhat smaller wick, will afford a whiter light.

In like manner cocoa-nut oil, which, during summer, even in our own climate, is perfectly fluid and capable of being burnt in a lamp, becomes thick at a somewhat lower temperature, being filled with white solid particles. These being separated, by gradual pressure, from the fluid portion, form a substance of about the same consistence as common tallow; and candles made of it will retain their solidity at any natural heat, out of direct sunshine, likely to occur in this country.

The cheapness, hardness, and great inflammability of common rosin, have been the occasion of many attempts to employ it as a material for candles, but with very indifferent success; for, when melted, its viscidity is such that it cannot readily rise, by capillary attraction, between

the fibres of the wick; and, in consequence, it is impossible to prevent such candles from guttering to a very inconvenient and wasteful degree. It has been endeavoured to diminish the viscidity by the addition of tallow, but this mixture is more fusible than tallow itself; so that if any advantage is gained on the one hand, it is lost on the other.

Having now treated, as fully as the occasion requires, of the manufacture of candles, and of the various inflammable substances employed, or proposed to be employed, in their composition, I proceed to consider the circumstances on which the good or ill burning of candles, and the whiteness and brightness of the light given out by them, appear mainly to depend.

According to the most accurate analysis of spermaceti, this substance is composed of 77·5 carbon, 12 hydrogen, and 9·5 oxygen. It is probable that the composition of tallow and wax does not differ materially from the above. The whole of the oxygen of the above compound will be saturated or neutralized by 1·2 of hydrogen, producing 10·7 of water; there remains, therefore, a clear balance of combustible matter to the amount of about 88·3, namely, the whole of the carbon, 77·5, and 10·8 of hydrogen. Pure hydrogen burns with a pale blue flame, scarcely visible in daylight, but producing the most intense heat with which we are acquainted; there is, therefore, no proportion between the light and heat of a burning body. Hydrogen is capable of combining with carbon in two proportions, one the double of the other. With one equivalent of the two ingredients, it forms a gas called carburetted hydrogen, which burns with a pale bluish yellow flame. With one equivalent of hydrogen, and two of carbon, it produces a gas called bicarburet of

hydrogen, or olefiant gas, which burns with a clear, bright, white flame. The problem, therefore, to be resolved, is so to regulate the combustion of the candle as to produce the greatest possible quantity of bicarburetted hydrogen. Carbon and hydrogen, in the proportions already mentioned, may produce, by their combination, 83·95 of bicarburet of hydrogen, 4·35 of hydrogen remaining uncombined: by such an arrangement the greatest possible quantity of bicarburet of hydrogen, and therefore of white light, would be produced. But the same materials, arranged in another way, would afford no bicarburet of hydrogen at all; but 83·95 of carburetted hydrogen, and 4·35 of carbon, would be uncombined. Such a mixture would give a yellow flame, with about 4 per cent of soot and smoke, and therefore would afford the least possible light. Or, we may conceive the materials arranged so as neither to produce smoke in burning, nor any deposit of soot on the wick; but to yield 78·15 of carburetted hydrogen, and 10·15 of bicarburetted hydrogen, which would burn with a yellowish white flame.

If we pass bicarburetted hydrogen through a red-hot tube, it deposits half its carbon, and is reduced to carburetted hydrogen: the condition, therefore, for burning a candle to the best advantage, as far as regards the quantity of light produced, is, that the oily vapour or bicarburetted gas should be burnt as soon as it is produced, without being previously exposed to any increase of temperature capable of decomposing it.

Bearing in mind these facts, let us now see what takes place in burning a tallow candle.

When first lighted, the heat begins to melt the adjacent solid tallow, which is absorbed by the capillary attraction

of the wick: the end of the wick projects hardly at all into the flame, and therefore the tallow ascends to the end of the wick, having as yet undergone no decomposition; when there, it comes in contact with the lower part of the flame, and whatever bicarburetted hydrogen is produced immediately burns with its characteristic white light, without undergoing any previous decomposition. After a few minutes, the flame, though larger than at first, gives less light, and assumes a decidedly yellow tinge; at this time so much of the tallow will have been consumed, as to leave the naked part of the wick considerably lengthened,—the flame, instead of hovering as it were on the top, will have extended half an inch or more down the sides, and will have increased both in length and in diameter, assuming the appearance of a thin film or hollow bladder, within which the vapour of the tallow as it rises becomes more and more heated, and consequently more and more decomposed. The film of flame that incloses it prevents the access of air; it cannot therefore burn till it has reached the top or point of the flame, and, by the time that it arrives here, much of it will have been decomposed: so that instead of giving a white light, without any residue, it will give a yellow light, and the carbon that the gas has lost will have attached itself to the top of the wick in the form of fungus-looking clots. The larger or thicker the wick, the greater is the cavity of the flame, and therefore the greater the proportion of tallow that is thus unprofitably employed. But in a candle made of so fusible a substance as tallow, it is impossible to have a thin wick; because, unless the melted tallow is absorbed and consumed as fast as it is melted, the little cup formed at top of the candle will overflow: hence, the thickness of the wick must bear a

certain proportion to that of the tallow, the inconvenience and loss from a guttering candle being as great as a diminution of its light. By snuffing off the burnt wick when it gets too long, a limit is put to the yellowness and smokiness of the flame; and therefore, in using tallow candles, the annoyance of snuffing them must of necessity be submitted to. Count Rumford states, as the result of his own experiments, that a tallow candle, which, when just snuffed, is giving out a degree of light estimated at 100, after eleven minutes was producing light equal only to 39; in nineteen minutes it was reduced to 23, and in twenty-nine minutes to 16, being scarcely one-sixth of the original quantity of light: on snuffing the candle, its light immediately became 100. A candle is snuffed too low, when the flame only just occupies the top of the wick; for in this case the absorption of the tallow being much diminished, while the heat is not diminished in the same proportion, the melted tallow accumulates in the cup till at length it runs over.

Spermaceti and wax are considerably less fusible than tallow; and therefore, as the ordinary heat of a candle melts less of these substances in a given time than of tallow, a thinner wick will be found sufficient to absorb the wax or spermaceti, in proportion as they melt. But there is another circumstance, besides the fusibility of the material, that regulates the thickness of the wick; and this is, the *degree* of fluidity which different liquids possess at the same temperature; for the rapidity with which melted wax and spermaceti, for example, rise by capillary attraction among the fibres of the wick, is in proportion to their respective degrees of fluidity. Now, the latter of these substances, when melted, is almost as limpid as water, which is by no means the case with wax. Hence,

although candles of wax and of spermaceti will, both of them, bear a thinner wick than candles of tallow, on account of their being less fusible, spermaceti admits of a thinner wick than wax, as being the more limpid when in fusion.

Several advantages arise from the use of a thin wick: in the first place, the cavity within the film of flame is less in proportion to the diminished diameter of the wick; and in the second place, the burnt wick, being very thin, is not able to support itself upright; it therefore twists on one side till it pierces through the film of flame, and, coming in contact with the air, is thus burnt off or snuffs itself. The gas produced by the decomposition of tallow, when burnt from a jet, produces as white a light as that from wax or spermaceti; the superiority, therefore, which these substances possess over tallow, when made into candles, depends entirely on their greater infusibility. In a very small wick, the whole of the gas that escapes from it comes immediately in contact with the air, and is burnt while in the state of bicarburetted hydrogen: hence, the thinner the wick the purer the light. On this account it is that the flame from the wax watch-light is so exceedingly white; but the wick of this kind of candle is so thin as not to absorb the whole of the wax as it melts, and therefore a large proportion of the wax would be lost by guttering, unless the following very ingenious contrivance was had recourse to: —the candle, while burning, is immersed in water nearly as high as the top of the wax, and thus the heat produced is prevented from melting down the exterior rim of the wax, the outside of it being in contact with the cold water.

I shall mention, before I conclude, two contrivances to enable tallow or other candles, requiring thick wicks,

to snuff themselves; one is the subject of a patent, I believe, taken out by Mr. Palmer. It consists in making the wicks double, or in two divisions; so that, in burning, the two halves separate from one another, and generally twist to opposite sides of the flame where they are burnt to ashes. The other was first brought before the public by Mr. E. Walker: it consists in inclining the candle at such an angle, that the end of the burnt wick shall project beyond the side of the flame, and so get consumed. The flame is not so bright as if the candle were upright and regularly snuffed, but is never so dull as it becomes without snuffing.